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NUMERICAL SIMULATION OF INDUCTION-FREE CURRENT GENERATION IN A TOKAMAK USING INTERMEDIATE FREQUENCY RANGE WAVES *)

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The method of creating and maintaining non-induction current in tokamaks using delayed electromagnetic waves of the lower hybrid (LH) frequency range possess the highest theoretical and experimentally confirmed efficiency. To predict the results of experiments on LH current generation, numerical calculations of the excitation, propagation and absorption of LH waves in plasma are carried out both using codes based on solving the wave equation and using codes using the ray trajectory method.

At the Ioffe Institute the numerical code FRTC [1-4] is developed, incorporated into the numerical code ASTRA [5], to solve the problem of propagation of electromagnetic waves of the intermediate frequency range in tokamak plasma and calculate the magnitude and profile of the generated current. The code calculates the radial trajectories of waves, the distribution of absorbed power in a tokamak, solves the one-dimensional dynamic Fokker-Planck equation and calculates the magnitude of the induction current. The spectrum of the antenna's starting decelerations is calculated by the GRILL3D code [6], the experimental plasma parameters are processed by the EFIT code [7], the plasma equilibrium is calculated for a specific moment in time in the discharge by the ASTRA code.

The results of calculations of the energy absorption distribution of LH waves in the FT-2 tokamak and helicons in the Globus-M2 tokamak using the numerical code FRTC [1-4] are presented, and a comparison with the results of the corresponding calculations with the full-wave numerical code WaveTop2D [8] is carried out. The comparison was carried out in a cold plasma model, as well as taking into account the warm permittivity tensor in the WaveTop2D code and the warm correction to the permittivity tensor when calculating the absorbed power in the FRTC code. The necessity of taking into account the gradient terms [9] in the dispersion equation when calculating the LH current in a spherical tokamak using the FRTC code is shown. It is shown that calculations using FRTC and WaveTop2D codes in cold and warm cases are in good agreement when taking into account gradient corrections.

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